THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 15

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

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Ex parte WILLIAM S. HEGLUND AND STEPHENS R. JONES

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Appeal No. 96-2285
Application No. 08/204,913[1]

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ON BRIEF

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Before BARRETT, FLEMING, and GROSS, ***Administrative Patent Judges***.

FLEMING, ***Administrative Patent Judge***.

DECISION ON APPEAL

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[1] Application for patent filed March 1, 1994.

This is a decision on appeal from the final rejection of claims 1 through 13, all of the claims pending in the application.

The invention relates to a switched reluctance machine based start/generator system utilizing fixed-angle current regulated generator control. Appellants disclose on page 8 of the specification that Figure 1 illustrates a switched reluctance machine 10 having a rotor (not shown) drivably coupled by shaft means 12 to a turbine engine 14. On page 10 of the specification, Appellants disclose that Figure 3 shows the switch reluctance machine phase winding 44 in series with two switches 46 and 48. As the switches 46 and 48 are gated, current flows from the dc distribution bus 20 to energize the winding 44. When the switches 46 and 48 are not gated, disconnected, the current is forced to flow through the cross-coupled diodes 50 and 52 to the dc distribution bus 20. On page 17 of the specification, Appellants disclose that the switches 46 and 48 are gated at a fixed angle, approximately 40 electrical degrees before alignment of the stator pole as shown in Figure 2. Appellants refer to this angle as the turn-on angle. Appellants further disclose that the switches 46 and 48 are disconnected at a fixed angle, at approximately 120 electrical degrees after alignment. Appellants refer to this angle as the turn-off angle. Appellants disclose on

pages 17 and 18 that the phase current resulting during the time period between the turn-on angle and turn-off angle is controlled by switching on and off the switches 46 and 48 during this time period. Appellants disclose on pages 11 and 12 that

the controller 22 shown in Figure 5 determines the modulation rate of the switches depending on variables such as the speed and load of the switched reluctance machine 10. On page 18 of the specification, Appellants disclose that Figure 8a illustrates the fixed angle, adjustable band control of the Appellants' invention for a given speed and a high system load. On pages 18 and 19 of the specification, Appellants disclose that Figure 8b illustrates the fixed angle, the same adjustable band control method for a smaller connected loading condition but at the same speed. Viewing Figures 8a and 8b, one observes that while the turn-on and turn-off angles are fixed, the phase current is controlled by the modulation rate of the switches 46 and 48.

The independent claim 1 is reproduced as follows:

> 1. An electric power starter/generator system for converting electrical energy from a remote dc electrical power source coupled to a dc distribution bus to mechanical energy to start a turbine engine in a start mode, and for converting mechanical energy from the turbine engine to electrical energy to power utilization equipment connected to the dc distribution bus in a generate mode, comprising:
> a switched reluctance machine having a rotor drivably coupled to the engine by shaft means, and a stator having first plurality of salient stator poles wound with phase windings, and rotor comprising a second plurality of salient rotor poles;
> an inverter having a dc input/output coupled to the dc distribution bus, and at least a first and a second switching means responsive to switching control signals for coupling each of said phase windings to the dc distribution bus, and at least a first and a second commutation means for cross-coupling each of said phase

windings to the dc distribution bus to allow
current flow back when said switching means are disabled;
rotor position resolving means positioned within said switched reluctance machine
for monitoring the angular position of said rotor, said resolving means generating a rotor position control signal;
current sensing means positioned in proximity to said phase windings for monitoring
current flowing in each of said phase windings, said current sensing means generating phase current sense signals;
voltage sensing means coupled to the dc distribution bus for monitoring dc
voltage at a point of regulation, said dc voltage sensing means generating a bus voltage sense signal;
a controller having a plurality of control inputs and outputs coupled to said inverter
for monitoring and controlling system performance during the start mode and the generate mode of system operation; and wherein
said controller monitors said rotor position control signal and generates said
switching control signals to enable at least said first and said second switching means for each of said phase windings at a fixed angle
prior to alignment of said rotor pole with said phase winding's associated stator pole thereby coupling said phase winding to the dc distribution bus and allowing dc phase current to flow from the dc distribution bus, through at least said first switching means, said winding, and at least said second switching means, said controller further generating said switching control signals to disable at least said first and said second switching means at a fixed angle
after alignment of said rotor pole with said phase winding's associated stator pole, thereby

decoupling said phase winding from the dc distribution bus and forcing dc current flow back from said phase winding, through at least said first and said second commutation means, and to the dc distribution bus to allow said switched reluctance machine to operate in the generate mode of operation; and wherein said controller monitors said phase current sense signals and said dc bus voltage sense signal, calculates a maximum phase current control signal and a minimum phase current control signal, and modulates said switching control signals to regulate said dc phase current within a range defined by said maximum phase current control signal and said minimum phase current control signal, said controller maintaining the bus voltage at a desired level thereby.

The Examiner relies on the following references:

Sember	5,012,172	Apr. 30, 1991
Stephens et al. (Stephens)	5,166,591	Nov. 24, 1992

Claims 1 through 13 stand rejected under 35 U.S.C. § 103 as being unpatentable over Sember in view of Stephens.

Rather than reiterate the arguments of Appellants and the Examiner, reference is made to the brief and answer for the respective details thereof.

OPINION

We will not sustain the rejection of claims 1 through 13 under 35 U.S.C. § 103.

The Examiner has failed to set forth a ***prima facie*** case. It is the burden of the Examiner to establish why one having ordinary skill in the art would have been led to the claimed invention by the express teachings or suggestions found in the prior art, or by implications contained in such teachings or suggestions. ***In re Sernaker***, 702 F.2d 989, 995, 217 USPQ 1, 6
(Fed. Cir. 1983). "Additionally, when determining obviousness, the claimed invention should be considered as a whole; there is

no legally recognizable 'heart' of the invention." ***Para-Ordnance Mfg. v. SGS Importers Int'l, Inc.***, 73 F.3d 1085, 1087, 37 USPQ2d 1237, 1239 (Fed. Cir. 1995), ***cert. denied,*** 117 S.Ct. 80 (1996) ***citing W. L. Gore & Assocs., Inc. v. Garlock, Inc.***, 721 F.2d 1540, 1548, 220 USPQ 303, 309 (Fed. Cir. 1983), ***cert. denied***, 469 U.S. 851 (1984).

Appellants argue on pages 8 through 9 and 11 through 13 of the brief that neither Sember nor Stephens teaches, individually or as a combination, a fixed angle control. In

particular, Appellants point out that both Sember and Stephens operate by varying the angle control.

We note that all of Appellants' claims recite a fixed angle control. In particular, Appellants' claim 1 recites "said controller ... generates said switching control signals to enable at least said first and second switching means for each of said phase winding at a fixed angle prior to alignment of said rotor pole with said phase winding's associated stator pole ... further generating said switching control signals to disable at least said first and said second switching means at a fixed angle after alignment of said rotor pole with said phase winding's associated stator pole ...." Appellants' claim 12 recites "enabling the switching means ... at a fixed angle prior to alignment of a rotor pole with the energized stator pole; disabling the

switching means . . . at a fixed angle prior to alignment of a rotor pole with the energized stator pole; disabling the switching means ... at a fixed angle after alignment of the rotor pole with the energized stator pole ...." Appellants'

remaining independent claim, claim 13, recites "enabling the switching means for a selected phase winding to allow current flow from the dc power bus to energize the selected phase winding for a period beginning at a fixed angle prior to alignment of a rotor pole with the energized stator pole, and ending at a fixed angle after alignment of the rotor pole with the energized stater pole ...." Therefore, we find that all of the claims before us require enabling the switching means at a fixed angle prior to alignment of a rotor pole with the energized stator pole and disabling the switching means at a fixed angle after alignment of the rotor pole with the energized stator pole.

The Examiner notes on page 4 of the answer that Sember fails to teach that the switches are enabled at a fixed angle prior to alignment of the rotor. On page 5 of the answer, the Examiner argues that while Stephens does not explicitly state that the turn angle is fixed, Stephens implicitly implies that this angle is fixed.

Upon a closer reading of Stephens, we find that Stephens fails to teach that the turn-on angle is fixed. Stephens

teaches in column 3, lines 19-59, that Figure 1 shows a conventional
switched reluctance machine drive configuration. In particular, Stephens discloses that Figure 1 shows SRM 10 as a three-phase
machine with its associated power invertors 12. The invertors 12 switch each phase windings 28, 30 and 32 by current switching devices (33 and 36), (34 and 37) and (35 and 38), respectively. Stephens discloses in column 3, lines 60, through column 4, line 12, that the current regulation means 51 receives phase current feedback signals and a Iref. Stephens further discloses that control means 50 provides a command reference current waveform IREF to current regulation means 51 and outputs firing signals to inverter 12 for energizing the machine phase winding in a predetermined sequence. Stephens discloses that the control means 50 is described in U.S. Pat. No. 4,739,240, hereinafter referenced as MacMinn.

Turning to MacMinn, we note that MacMinn teaches that the control means in column 2, lines 55-66, include a memory which stores a plurality of standard multiphase firing patterns.

Each pattern contains a sequence of stator phase firing pulses over an electrical cycle of the drive. Each pulse of a particular pattern is preferable of equal duration and has a turn-on angle
corresponding to a different initial rotor position. Therefore, MacMinn teaches varying the turn-on angle and thereby fails to
teach enabling the switching means at a fixed angle prior to alignment of a rotor pole with the energized stator pole and

disabling the switching means at a fixed angle after alignment of the rotor pole with the energized stator pole as recited by Appellants' claims.

Stephens is an improvement of the prior art disclosed by Figure 1. However, Stephens improves the current regulation means 51, not the control means 50. Stephens teaches in column 5, lines 3-9, that it has been found that by regulating current in order to produce phase current waveforms during generating actions that are approximately mirror images, about

the aligned axis, of the phase current waveforms during motoring action results in a lower chopping frequency and lower switching losses than the conventional current regulation schemes.

Stephens teaches in column 5, lines 45-50, that Figure 4 illustrates a preferred embodiment of the control circuitry of the current regulation means. Stephens teaches in column 5, line 51, through column 6, line 26, that the control circuitry of the current regulation means receives a signal proportional to the sensed phase current, Isense, a commanded reference current waveform, Iref, and a logic signal, INTERVAL signal. Stephens discloses in column 6, lines 27-66, that the INTERVAL signal
determines the turn-on and turn-off angle. Stephens is silent as to how the interval is determined.

Returning to Figure 1, Stephens shows that the machine control means 50 provides the drive signal that determines the

turn-on and turn-off angle. As pointed out above, Stephens discloses that the machine control means 50 is disclosed by

MacMinn. MacMinn teaches that the turn-on and turn-off angle both vary depending on the load and speed of the SRM. Therefore, Stephens' system also varles the turn-on and turn-off angle and fails to teach enabling the switching means at a fixed angle prior to alignment of a rotor pole with the energized stator pole and disabling the switching means at a fixed angle after alignment of the rotor pole with the energized stator pole as recited in Appellants' claims.

The Federal Circuit states that "[t]he mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification." ***In re Fritch***, 972 F.2d 1260, 1266 n.14, 23 USPQ2d 1780, 1783-84 n.14 (Fed. Cir. 1992), ***citing In re Gordon***, 733 F.2d 900, 902, 221 USPQ 1125, 1127 (Fed. Cir. 1984).

We find that the Examiner has failed to show that the prior art taught or suggested enabling the switching means at a fixed angle prior to alignment of a rotor pole with the energized

stator pole and disabling the switching means at a fixed angle after alignment of the rotor pole with the energized stator pole. We are not inclined to dispense with proof by evidence when the
proposition at issue is not supported by a teaching in a prior art reference or shown to be common knowledge of unquestionable demonstration. Our reviewing court requires this evidence in order to establish a ***prima facie*** case. ***In re Knapp-Monarch Co.***, 296 F.2d 230, 232, 132 USPQ 6, 8 (CCPA 1961); ***In re Cofer***, 354 F.2d 664, 668, 148 USPQ 268, 271-72 (CCPA 1966).

We have not sustained the rejection of claims 1 through 13 under 35 U.S.C. § 103. Accordingly, the Examiner's decision is reversed.

REVERSED

LEE E. BARRETT)
Administrative Patent Judge)
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) BOARD OF PATENT

MICHAEL R. FLEMING Administrative Patent Judge	)	APPEALS AND INTERFERENCES
ANITA P. GROSS Administrative Patent Judge	)	

MRF/sld

Jeffery J. Makeaver
Sunstrand Corporation
Patent Dept. #441-3
4949 Harrison Ave.
P.O. Box 7003
Rockford, IL 61125-7003